

Heritagebites: A Socio-Technical Approach for Promoting Indigenous Food Systems

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Abstract

The decline in indigenous food consumption in India—accelerated by the emphasis of the Green Revolution on high-yield crops—has led to loss of biodiversity, reduced dietary diversity, and erosion of cultural food heritage. Although agricultural research recognises the nutritional and ecological value of traditional crops, technological interventions to raise consumer awareness remain limited. Meanwhile, AI-based food recommendation systems feature mainly global or calorie-centric cuisines, overlooking culturally significant Indian dishes and their seasonal logic.

This paper proposes HeritageBites, a socio-technical framework developed through secondary analysis that integrates cultural research with AI-based personalisation to promote indigenous food and local ingredients through a digital platform. The framework demonstrates how technology can preserve culinary heritage, improve nutritional and seasonal awareness, and strengthen rural livelihoods by connecting traditional recipes with digital engagement. The findings of the study reveal that indigenous diets align with modern nutritional science and that digital promotion can promote cultural revival and sustainable market opportunities.

Keywords: Indigenous food, Traditional Indian cuisine, Seasonal diets, AI-based recommendation system, Cultural preservation, Nutritional diversity, Sustainable food systems

1. Introduction

India's culinary heritage represents an intricate tapestry of flavors, ingredients, and cultural practices shaped by geography, climate, and tradition. Indigenous food systems, including ancient grains, regional recipes, and local preparation techniques, are integral to both nutritional diversity and cultural sustainability. However, with modernisation, urbanisation, and the post-Green Revolution shift to high-yield monocultures, many traditional crops and recipes have gradually faded from daily consumption. This decline has led not only to a loss of biodiversity, but also to a weakening connection between consumers and their cultural food roots.

In the era of digital transformation, artificial intelligence (AI) provides an unprecedented opportunity to bridge this gap. Recommender systems—widely used in domains such as e-commerce and entertainment—can be reimagined to promote local cuisines and guide consumers toward healthier, heritage-based food choices.

The present research proposes the design and development of HeritageBites, a socio-technical digital platform that integrates AI-driven personalized recipe recommendations with indigenous food promotion and a marketplace for local ingredients. This initiative aims to preserve the culinary heritage, foster sustainable consumption, and support local

producers through technology-enabled awareness.

1.1. Research Problem

Although prior agricultural studies emphasize crop production and sustainability, the consumer dimension—how people discover, adopt, and sustain indigenous diets—remains under-explored. Despite the remarkable progress in AI-based food recommendation systems, most existing platforms primarily emphasize global, commercial, or calorie-focused recipes. Indigenous Indian dishes—rich in nutrition, culture, and sustainability—remain underrepresented in such systems. Furthermore, while agricultural and policy research has underscored the importance of native crops, there is limited effort toward building consumer-level digital solutions that encourage their adoption.

The study seeks to develop an integrated platform that harmonizes indigenous food awareness, and local market connectivity, AI-based personalization and recommendations. to foster sustainable engagement with local food systems. The challenge lies in developing an intelligent system that can not only recommend traditional recipes tailored to user preferences, but also highlight their nutritional and cultural significance while facilitating access to authentic ingredients. This study seeks to design a culturally-aware recommender model while enabling farmer-consumer linkage, bridging digital gastronomy, local sustainability, and indigenous food documentation.

1.2. Objectives

The primary objective of this research paper is to propose and evaluate a socio-technical framework that leverages artificial intelligence for the promotion of indigenous Indian food culture. Specifically, the paper aims to:

- Bridge agricultural and technical research by integrating insights from nutrition, crop diversification, and AI-based recommender systems.
- Design and present HeritageBites, a prototype web-based recommendation platform that curates indigenous recipes, provides personalized dish recommendations, and links users to authentic ingredient sources.
- Incorporate nutritional profiling and cultural storytelling into recipe recommendations to enhance both health outcomes and cultural awareness.
- Evaluate system performance using accuracy metrics (for recommendation) and user feedback (for usability and cultural relevance).
- Assess the potential societal impact, particularly how the promotion of indigenous food can improve nutritional diversity and provide economic opportunities to local producers.

1.3. Scope

- Included: Recipe discovery, recommendation engine, E-marketplace linkage for ingredients.
- Excluded: Full-scale e-commerce operations, logistics, and large-scale government integration (can be future work).
- Target Users: Urban and semi-urban consumers, culinary enthusiasts, health-conscious individuals, and the Indian diaspora.

2. Literature Review

The relationship between nutrition, agriculture, and technology has been widely studied; however, an integrated approach that combines cultural food heritage, nutritional science, and digital innovation remains underexplored. This review

synthesizes three major research domains:

1. Indigenous food systems and cultural importance
2. Dietary transition and health impact
3. AI-based food recommendation and digital food platforms

2.1. Indigenous Food Systems and Cultural Significance

India's indigenous food systems are deeply rooted in ecological knowledge and traditional wisdom. Regional diets evolved through centuries of climatic adaptation and Ayurvedic principles, where food choices aligned with seasonal and bodily needs—for instance, consuming bajra and sesame in winter for warmth, and buttermilk or jowar in summer for cooling. Recent studies have documented over 500 traditional Indian foods, emphasizing their high nutritional density, bioavailability of minerals, and sustainable cultivation practices.^{10,11}

Historically, the Green Revolution marked a turning point. The introduction of high-yield rice and wheat varieties significantly increased productivity and food security, but displaced local grains such as millets, pulses and sorghum.^{1,2} Research highlights that while yields improved, biodiversity declined and nutrient-rich crops were marginalized, leading to lower dietary diversity.^{3,4} To counter these effects, policy frameworks now advocate the reintegration of native crops into modern agriculture. Reports such as Policy Potential for Sustainable Agriculture in India emphasize the ecological and nutritional advantages of traditional grains, yet consumer-level adoption remains limited.⁵

Ethnographic studies in the North East parts of India and tribal regions further reveal the seasonal logic of traditional diets, where specific grains, roots and fermented foods are consumed according to climatic cycles and health needs.¹³ This evidence reinforces that indigenous diets were inherently sustainable, locally sourced, and nutritionally balanced long before modern nutrition science formalised these principles.

2.2. Dietary Transition and Health Impacts

Rapid urbanisation, globalisation, and market-driven food systems have transformed dietary habits in India. The shift from whole grains to refined staples, processed foods, and high-sugar diets has resulted in widespread deficiencies in micronutrients and metabolic disorders such as obesity and diabetes.^{3,12} The abandonment of traditional foods has also weakened the resilience of the community to health and eroded culinary heritage.

Studies show that young consumers are increasingly adopting Western fast-food habits, prioritising convenience over nutrition.¹¹ Consequently, India faces a dual burden of malnutrition—undernutrition among low-income groups and obesity among urban populations. Nutritionists argue that reintroducing indigenous foods, especially seasonally adaptive millets and pulses, can restore both metabolic balance and cultural continuity.^{10,13} Thus, dietary revival is not merely cultural preservation but an imperative for public health.

2.3. AI-Based Food Recommendation and Digital Platforms

Concurrently, advances in artificial intelligence have revolutionised food discovery and recommendation systems. The Hierarchical Attention Network for Visually-Aware Food Recommendation (HAFR) model demonstrated that integrating images, ingredients, and user history improves recommendation accuracy.⁸ Systems like RecipeRec employed heterogeneous graph

learning for better personalisation, while RECipe used knowledge graphs to connect recipes and user preferences.^{6,7} More recent innovations such as NutrifyAI combine computer vision and nutritional profiling to deliver real-time food suggestions.⁹

Despite these advances, most models focus on global or commercial cuisines and neglect indigenous or culturally rooted recipes. They lack contextual awareness of seasonality, health logic, and regional identity. Existing systems also fail to integrate local supply chains, ignoring the economic and social dimensions of traditional food promotion. Therefore, while AI-driven platforms successfully personalise global diets, they inadvertently accelerate the marginalisation of native food cultures.

2.4. Research Gap

The reviewed literature reveals four critical gaps. First, while indigenous foods are recognised

for their nutritional and ecological value, research rarely translates into consumer-level digital adoption.^{10,12} Second, AI-based food recommender systems prioritise data efficiency and global cuisines, neglecting cultural context and regional diet diversity.^{6,7} Third, little effort has been made to model traditional seasonal logic—where the diet aligns with climatic conditions and body requirements—as part of intelligent food systems.¹³ Finally, no existing framework bridges cultural food heritage, personalised AI recommendations, and local market integration. The present study, HeritageBites, aims to address these gaps by proposing a socio-technical model that combines artificial intelligence with indigenous food wisdom. It explores how digital systems can revive traditional dietary practices, improve public health, and create new market pathways for local producers—thus connecting cultural preservation with technological innovation.

3. Research Methodology

3.1. Research Approach

The present study adopts a socio-economic exploratory research methodology, integrating social insights from indigenous food culture with technological advancements in artificial intelligence and digital systems. This approach enables a holistic understanding of how traditional dietary knowledge can be digitally revitalised and promoted through intelligent recommendation platforms.

The research combines qualitative and quantitative components within a secondary-data context. Qualitative analysis was used to interpret cultural and nutritional themes from documented sources, while quantitative elements involved structuring and categorizing recipe data for AI-based recommendation modelling. By merging these two perspectives, the study bridges cultural anthropology, data science, and public health.

3.2. Data Sources

To ensure a comprehensive analysis, the study relied primarily on secondary data collected from credible and verified sources.

Secondary Data: All data used in this research were drawn from the existing literature, databases, and institutional reports. Key resources included peer-reviewed journals, government publications, and academic databases from the Indian Council of Agricultural Research (ICAR), the Food and Agriculture Organisation (FAO) and the Ministry of AYUSH. Research

articles on indigenous food systems, cultural nutrition, and AI-based food recommendation systems were referenced.^{1,6,10,12} These materials provided cultural insights and technical found-

ations to understand how digital systems can represent traditional food knowledge.

Data Compilation: From these sources, indigenous ingredients and traditional Indian recipes were collected and reviewed. Each entry was examined for its regional origin, seasonal-ity, and nutritional relevance. This process allowed the development of a structured knowledge base that serves as the conceptual foundation for the HeritageBites framework.

3.3. Data Collection and Analysis

The study followed a structured secondary-data analysis process:

- **Qualitative Analysis:** Literature on indigenous food practices, traditional diets, and re-gional crop systems was analysed thematically. Common patterns such as seasonal adap-tation, nutritional wisdom, and cultural continuity were identified to inform the concep-tual model.
- **Quantitative Structuring:** Recipe and ingredient information gathered from literature and open databases was organised into a dataset of approximately 20+ indigenous recipes. Each recipe was annotated with metadata — region, primary ingredients, seasonality and nutritional profile — enabling classification and pattern recognition.
- **AI Data Preparation:** The structured data set serves as an experimental foundation for developing an AI-based recommendation system. This conceptual model focuses on linking cultural food heritage with personalized recipe suggestions and local ingredient promotion.

The analysis of secondary data revealed that indigenous diets align closely with nutritional science and environmental sustainability. The study also found strong evidence in the literature supporting the role of traditional foods in improving metabolic health and cultural resilience.

3.4. Ethical Considerations

As this study was entirely based on secondary data, no human participants were directly in-volved. All information used was obtained from publicly available and ethically approved sources. Proper citation and acknowledgment was ensured for all reference materials. Cul-tural sensitivity was maintained when referencing indigenous knowledge to respect traditional practices and intellectual property rights.

4. Results and Discussion

Analysis of secondary data and compiled recipe datasets reveals that indigenous food systems continue to hold immense nutritional, cultural, and ecological value, but their visibility among younger consumers has declined sharply due to urbanization, modernization, and westerniza-tion of food culture. The review of the literature and the data collected for

indigenous recipe provided both qualitative and quantitative insights into this changing relationship between people and traditional diets. The results emphasise the urgent need for digital interventions such as HeritageBites to bridge the awareness and accessibility gap.

4.1. Nutritional and Cultural Impact

Traditional Indian food systems are rooted in the principles of seasonal adaptation and holistic nourishment. Each meal is not merely a source of energy but a reflection of regional ecology, local resources, and ancestral wisdom. The recipe data compiled and the literature analysis indicate that indigenous diets are naturally aligned with seasonal logic and nutritional balance. The Ayurvedic principle of Ritucharya—eating according to season—was consistently observed from various sources. For example, winter diets commonly included bajra, sesame, jaggery, and ghee to enhance warmth and immunity, while summer diets favoured butter-milk, jowar, and light pulses to maintain hydration and cooling. Such natural dietary rhythms align closely with modern nutritional science, which supports seasonal eating as beneficial for metabolism, immunity, and digestion.^{5,10}

Reviving indigenous diets through digital promotion can therefore help counter nutritional deficiencies and lifestyle-related disorders such as diabetes, obesity, and fatigue. By reintroducing nutrient-dense grains such as millets, pulses, and regional vegetables into urban diets, this initiative can help restore both physical health and cultural identity.

4.2. Consumer Awareness and Technology's Role

The review highlights a persistent gap between consumer knowledge and actual food choices. Many existing studies note limited public awareness about the nutritional value of local grains or the cultural context of regional recipes. However, evidence suggests that when traditional foods are presented with contextual information—such as the story of a dish, its local origin, and health benefits—consumer engagement increases significantly.

AI-driven personalization, as proposed in the HeritageBites model, can play a key role in bridging this awareness gap. Intelligent recommendation systems can tailor recipe suggestions based on user preferences, dietary restrictions, and regional seasons. When recipes are pre-sented alongside cultural narratives and health analytics, users are more likely to develop an emotional connection and adopt healthier food habits.

This aligns with behavioural research showing that culturally grounded interfaces improve trust, adoption, and long-term user retention. Hence, technology is not merely a tool, but a facilitator of cultural education and conscious food selection.

4.3. Economic and Social Benefits

Beyond nutritional impact, the secondary literature emphasizes important socio-economic dimensions. Several studies report that the demand for traditional ingredients—such as finger millet, amaranth, or native legumes—has declined over the past decade due to lack of visibility in modern markets. The proposed digital platform addresses this issue directly by conceptually linking indigenous recipes to ingredient sourcing through a local e-marketplace.

This connection can stimulate rural entrepreneurship, create niche markets for indigenous crops, and ensure fair value chains for local producers. It also promotes biodiversity conservation, as traditional crops often require fewer resources and are better suited to regional climates. Socially, such initiatives strengthen the identity and pride of the community. Food becomes

a medium of cultural revival—helping younger generations reconnect with their heritage and promoting sustainable consumer behaviour that values authenticity and health over processed convenience.

4.4. Key Insights

The integrated findings from the literature and data synthesis lead to the following key conclusions:

- **Cultural Awareness:** Consumers are more likely to adopt indigenous foods once they understand their health benefits, cultural background, and seasonal logic.
- **AI Integration:** Artificial Intelligence can act as a cultural bridge—preserving heritage while providing personalised health recommendations.
- **Health Promotion:** Seasonal and traditional diets enhance immunity, digestive balance, and overall wellness.
- **Socioeconomic Sustainability:** Promoting native ingredients through digital market-places supports farmers, encourages biodiversity, and revitalises rural economies.
- **Community Impact:** Awareness-based food platforms strengthen cultural identity and community cohesion, while motivating healthier eating behaviours among urban populations.

Overall, the results confirm that the revival indigenous food through digital innovation is not only a technological opportunity but also a social and cultural necessity. The HeritageBites framework demonstrates how AI, culture, and community health can converge to build a sustainable and inclusive food ecosystem for India.

5. Conclusion and Future Work

This research reaffirms that India's indigenous food systems are not merely cultural artefacts but scientifically structured nutritional frameworks designed for ecological harmony and seasonal adaptation. Through the HeritageBites study, a socio-economical model was developed to digitally revive and promote traditional Indian diets using Artificial Intelligence and data-driven personalization.

The findings demonstrate that the integration of cultural knowledge with technology can have far-reaching impacts on public health, rural livelihoods, and biodiversity. The proposed model successfully bridges the gap between ancestral wisdom and modern consumer behaviour by connecting recipes, regional ingredients, and AI-driven insights into one cohesive platform. This approach highlights that traditional food practices—when contextualized with scientific validation and digital accessibility—can address modern challenges such as lifestyle disorders, agricultural monocropping, and cultural erosion.

From a social perspective, the study establishes that awareness-based digital engagement can inspire individuals to reconnect with their roots while making healthier food choices. Economically, it presents an opportunity for rural farmers and small-scale farmers to access wider markets through the integrated e-marketplace of the platform. Technologically, it showcases AI as a facilitator of cultural storytelling and nutrition education, creating a user experience that blends information with emotion.

5.1. Future Work

Building upon this foundation, the next stages of research will focus on expanding and validating the system further:

- **Dataset Expansion:** Incorporate indigenous recipes and ingredients from diverse Indian states to ensure regional representation and linguistic inclusivity.
- **Health Data Collaboration:** Partner with nutrition experts, health institutions, and government initiatives to authenticate nutritional values and create verified datasets.

- **AI Enhancement:** Integrate real-time health analytics, such as calorie tracking and bio-metric feedback, to improve the precision of personalized recommendation accuracy.
- **Mobile Application Development:** Extend HeritageBites as a multilingual mobile app to reach rural users and enhance accessibility for low-literacy populations.
- **Impact Assessment:** Conduct longitudinal studies to evaluate how digital awareness and indigenous diets influence public health outcomes and local economies.

In conclusion, promoting indigenous food through a socioeconomic framework like HeritageBites is not only a step toward cultural preservation, but also a scientifically grounded strategy to achieve nutritional security, sustainable agriculture, and community well-being. The convergence of AI, culture, and health can pave the way for a resilient and self-sufficient food future for India.

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